APPENDIX E

OPTIONS TO INCREASE SWEEPING FLOW

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APPENDIX E

Options for Increasing Sweeping Flows
Past the Red Bluff Pilot Pumping Plant Intake

The designers of the RBDD Pilot Pumping Plant (PPP) have identified the need to generate greater sweeping flows past the PPP facility. River channel work will take place following construction of the PPP. The designers initially recommended five possible courses of action to facilitate greater sweeping flows at the intake of the PPP. These options include:

1) gate manipulations at RBDD;
2) dredging of the site above and below RBDD, and;
3) use of groins or other channel control structures in the river;
4) constricting the channel cross section above the dam; and
5) a combination of the above.

Continued hydraulic model studies combined with comments from the first and second revised Draft EA review have led Reclamation to select a version of number 5) above as the channel modification option recommended for implementation. This option incorporates gate manipulation at RBDD with limited upstream dredging and has comparable flow manipulation benefits to the other channel modification options considered. Use of gate manipulation with limited dredging allows adjustment for specific river flows, bar deposition, or flow velocity objectives. Reclamation believes that the biological impact of this option is no more severe than the other options considered in that shear zones would be limited to one large separation. In addition, when at all possible, depending on river flow velocity and bar deposition, all gates will be maintained in a raised position. This option can also be achieved with minimum cost with no in-river construction (except dredging).

It is anticipated that depending on river discharge, the extent of sediment deposition, and the number of PPP pumps in operation; gates would be opened from the left and right banks with the center gates closed. Recommended gate operations will be determined through the continuing laboratory physical model investigation and through field flow and fisheries investigations. No more than 1.2 ft of differential would be generated across RBDD. With low river flows and substantial deposition; gates 1, 2, 10, and 11 would possibly be open with gates 3 through 9 closed. As river discharges increase or the required magnitude of sweeping flows decrease additional gates would be opened. It is expected that the fisheries agencies will be actively involved in the collection and review of hydraulic and biological data and the selection of recommended operations.

Use of gate manipulations (selective gate operation) can allow for periodic or short term modification of the flow pattern, if biological considerations permit, for stronger sweeping flows past the PPP inlet or for dispersion of predators below normally closed gates. On occasions, additional gates may need to be opened depending on river flow, especially during flooding conditions.

In addition to gate manipulations, limited upstream dredging will be required. The amount will depend upon the condition of the river and sediment load from

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Red Bank Creek at the time. Since the river condition and sediment load are transient in nature, a worst-case situation such as existed prior to the February/March 1993 flooding, was considered for determining dredging quantity and location. Presently the river would require less dredging than is discussed below (estimate of dredging for current condition is less than 2,000 cubic yards).

Dredging would occur above gates 9, 10 and 11 and below Red Bank Creek. Based on the February, 1993 deposition, the maximum amount of material to be moved would be 5,000 cubic yards. The maximum dredging zone is somewhat pie shaped, with the arc side facing northeast, and is 200 feet long, 50 feet wide and up to 5 feet in depth. The material removed is to be relocated toward the center of the river, or removed and deposited in disposal ponds located adjacent to the Tehama-Colusa Canal, if necessary (See Figure A-1).

Temporary dikes and/or sediment control curtains will be used to control turbidity and sediment spread during dredging if necessary. River flow and velocity may be controlled somewhat by directing more flow to the east side of the river during dredging operations. Dredging would occur during the gates up time and when potential impact on salmon movement, spawning, and rearing is minimized. Input from the resources agencies indicate that a January through April 15 window for dredging activities would be desireable. No downstream dredging is anticipated in conjunction with gate manipulation. Future upstream dredging may be limited with selective gate operation used to control deposition, and may be repeated with a frequency that would offset any significant river sediment depositions.

The initial five alternatives are discussed as follows:

1.) Gate manipulations

Discussion:

Operation of the RBDD gates can be used to increase velocities adjacent to the RBPPP site. Gate use can be modified and thus adjusted to specific river and bar conditions. Indications are that the influence (both upstream and downstream of RBDD) of gate manipulation will be limited by bar characteristics. Depending on the bar, gate manipulation (that generates no more than the maximum allowable 1.2 ft differential) by itself may not generate the objective 1.0 to 4.0 ft/s sweeping velocities. Recommended gate operations which may include a recommendation not to use gate control will be selected through biological and hydraulic investigations.

Gate manipulation will generate a head differential at RBDD which may retard fish passage. Gates would be manipulated generating head differentials that are no greater than the current 1.2 ft criteria. Depending on operation, gate manipulation will also create a large slack water zone, mid-channel, downstream of the dam. Concentrated flows would pass RBDD near both banks (through gates 1, 2, 3, 9, 10, and 11). This flow distribution may generate increased predation.

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Use of gate manipulation would allow for periodic or short term modification of flow fields. For example if biological considerations allowed; short term flow concentration that would generate stronger sediment sluicing flows at the RBPPP intake could be generated. Likewise period manipulation of all gates may be attempted to disperse predators.

Preliminary Assessment:

This alternative will allow for manipulation of gates at RBDD with no construction. With closure of specified gates, hydraulic conditions would be altered and flows through RBDD would be redirected towards the intake of the PPP. Greater flows at the intake will sweep fish past the intakes, ameliorate trash accumulation, and reduce sediment deposition.

Upstream fish passage should not be hindered by this activity. The closure of gates may result in the redirection of the downstream migration of juveniles and greater contact with the PPP facility. It is important to note that the PPP is designed to pass fish with minimal impact. Even though more fish may be redirected to the vicinity of the facility, resulting greater flows from this action should facilitate greater fish passage past the intakes.

A possible negative effect could be the creation of predator habitat behind gates that are lowered to generate the sweeping flows. Operators could intermittently schedule gates to be opened to retard possible predator buildup associated with gate manipulation. Any predator buildup at the intake would have to be dispersed. Biological monitoring and evaluation of the site will determine if predator removal is warranted.

2.) Dredging of site above and below RBDD.

Discussion:

The existing sediment deposition, both above and below RBDD, is likely the single most important factor influencing RBPPP site hydraulics. Dredging of deposition from both above (possibly up to Red Bank Creek) and below the dam would substantially strengthen RBPPP sweeping flows. Required dredging frequency is uncertain but may be once or twice a year. The extent of required dredging will be identified through ongoing hydraulic investigations. (Figure A)

Options for dredging or deposition removal are as follows: 1) use of a hydraulic cutter head suction dredge that would be done from a barge above the dam when RBDD gates are down and the Lake Red Bluff pool is present, 2) use of a dragline or other bank based removal done when the river is at a low flow and with RBDD gates up or 3) possibly by displacing the bar material into the thalweg for river transport.

Dredging and deposition removal options will generate turbidity and transport of the fines. Redeposition of fines can adversely effect

incubating eggs and larval fish emergence. Turbidity control curtains may be used to partially contain generated turbidity. Curtains however are only effective in low velocity zones. Spawning activities below RBDD will be reviewed and deposition removal conducted during biologically acceptable windows.

Preliminary Assessment:

This option involves channel modification of areas located above and below RBDD. Possible modifications include partial or total removal of gravel deposits (above elevation 235) at the confluence of Red Bank Creek and Sacramento River. Options for deposition reduction include redistribution of bar material across the channel or dredged removal. Redistribution or dragline removal would be done during low water conditions to minimize water quality concerns associated with the dredging action. Hydraulic cutter head suction dredge removal of deposition above the dam would be conducted from a barge when Red Bluff Lake is pooled. Every effort will be made to schedule activities so that impacts on spawning adults, subsequent incubation period and fry emergence will be minimized.

Control berms or check dams will be constructed in the river to allow metering of suspended material as appropriate. Dredging activities will be monitored pursuant to state water quality requirements. No material will be removed from the river if redistribution is used. Gravel would be redistributed in the river to form proper channelization. Sediment disposal basins, constructed for use with the Tehama-Colusa Canal Settling Basin, could be used with options requiring sediment removal. There is a possibility that suspended material may impact spawning areas below the site. The impact of this action could be reduced if flushing flows are incorporated via gate manipulation or flood releases upstream. It is recognized that sediment deposition will occur in areas adjacent to the PPP and regular dredging will be required to maintain the facility.

3) Use of groins or other channel control structures in the river; and
4) Constricting the channel cross section above the dam.

Discussion:

Use of groins or other channel control structures - It is anticipated the groins could be used to maintain the thalweg on the right side of the channel through RBDD and past the RBPPP intake. The groins would be located primarily above RBDD and possibly also in the RBDD tailwater. The groins would establish channel cross section with submerged controls (sheet pile, rock fill, etc.) that would maintain a natural bend morphology with shallower channel to the left and the thalweg to the right. The structures could be designed to minimize flow separation and the creation of predator habitat. This design has the potential to aggressively sluice Red Bank Creek deposition and maintain a strong sweeping flow past

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RBPPP. This option likewise would be developed through biological and hydraulic investigations. (Figure B)

Constricting channel cross section above the dam - The left bank of the river could be displaced towards the right bank thus constricting the river channel approaching the dam by displacing the left bank toward the right bank which would establish a stronger current past Red Bank Creek. The objective of this effort would be to degrade the Red Bank Creek bar and increase flow past the RBPPP intake. The channel constriction would extend from several hundred feet above Red Bank Creek to 100 to 200 ft above RBDD (Figure C). It appears that channel width would have to be reduced approximately 300 ft to a width of approximately 450 ft. The restricted channel would likely be benched at approximately elevation 240. The constricted channel would overtop starting at a river discharge of approximately 10,000 ft^3/s and would be fully submerged when RBDD gates were down.

The channel constriction could be constructed with driven sheet pile, or riprap surfaced embankment fill. Depending on how the constriction was transitioned back to the left bank, a separation zone (that possibly could extend through and below RBDD) could result in deposition and establishment of predator habitat. It may be difficult with this structure to sustain a strong current through the dam and past the RBPPP intake.

For optimum effectiveness in sustaining sweeping flows, accessory use of submerged groins and/or limited dredging may be required. These additional structures would reduce future deposition and thus would reduce the need for future dredging or deposition removal. Additional right bank erosion protection between the headworks and Red Bank Creek may be required. The channel constricting structure would seal lower entrances to the left bank slough which may or may not be of biological concern. Care should be taken to assure that the structure does not adversely effect the performance of RBDD. This, and all other alternatives which involve contruction or the movement of riverbed materials, would have to be scheduled to minimize biological impacts.

Preliminary Assessment for options 3 and 4:

These options involves the use of submerged controls (ie. sheet pile, rock fill) that will allow natural stream bed morphology to be maintained. This design will provide for sluicing the Red Bank Creek deposition and the generation of strong sweeping flows past the PPP. The potential sites for these structure would be above and/or below RBDD. The major biological consequences for this activity center around possible predator habitat established by the structure. Biological monitoring is required to ascertain the need of predator removal or redistribution.

5) Combination

* Combinations of the above -

Most likely, a combination of the options discussed above will yield the most effective option for providing needed sweeping flows. Additional study with the physical model, and continuing coordination with the resource agencies will be utilized to develop an alternative that provides the needed hydraulic characteristics with a minimal impact to fishery resources.

Potential Impact on Salmonid and Riparian Habitat

Normally, there is very little fish spawning activity in the immediate vicinity of the RBDD and the PPP project site. Thus, the various alternatives that may be utilized to generate sweeping flows are not expected to have a significant impact on salmon spawning.

For riparian habitat, the immediate impact will be the removal of vegetation before construction begins. Other vegetation adjacent to the area would not be negatively impacted by greater sweeping flows, since the reach below the dam is historically subjected to great fluxuations in flow regimes due to seasonal changes wihich recur every year.

Limitations of Study to Date

The initial alternatives for increasing sweeping flows that are presented in this document were developed through preliminary physical model investigations and consultation between Reclamation engineers and fisheries biologists. The conceptual details presented, the size and extent of deposition removal and the structures and their expected performance characteristics, and potential biological influences are all approximate. This document presents a general overview of the initial alternatives with associated biological and engineering concerns. Ongoing model studies combined with Draft EA review comments have led to selection of a recommended alternative. The alternative selected and its biological and physical influences will be field evaluated as part of the RBPPP evaluation. Any needed modifications as supported by ongoing field evaluations will be incorporated only after separate environmental documentation is provided.

Additional Studies - Alternative Development and Field Verification

The recommended alternative and any subsequent alternatives that may become necessary will be evaluated and monitored for environmental and biological considerations before adoption/inclusion. The development of alternatives and their selection along with design, and field verification (with refinement) will be achieved by:

* Conducting detailed physical model investigations of the recommended alternatives.

* Initiating monitoring and documentation of the in-river fishery (this is a major task of the planning studies, supplemental data development, and pilot pumping plant evaluation as outlined in the Program Plan of Study for the Red Bluff Diversion Dam Fish Passage Program).

* Review of the available data and findings from the above studies by Reclamation and resource agencies.

* Implementation of the recommended alternative or selection of any subsequent alternative or sequence of alternatives to be pursued by Reclamation and the resource agencies, if the recommended alternative proves to be inadequate hydraulically or biologically.

* Development of a design by Reclamation.

* Construction.

* Field evaluation of the biological and physical impact of the flow modification and associated structures (included in the study scope as outlined in the Program Plan of Study for the Red Bluff Diversion Dam Fish Passage Program).

* Review of field data with alteration of flow modification and associated structures by Reclamation and resource agencies.

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